Low-cost inverters through manufacturing

OAAT ACCOMPLISHMENTS

Automotive Integrated Power Module: SatCon

Challenge

The prohibitive cost of power electronics has greatly hampered the design and production of many power electronic systems. Automotive electric and hybrid electric vehicles (HEVs) are among those applications in which high costs are a significant issue. These vehicles require a low-cost, lightweight, 55-kW AC motor converter with all components integrated into one compact and lightweight module. The Automotive Integrated Power Module (AIPM) Program addresses this challenge.

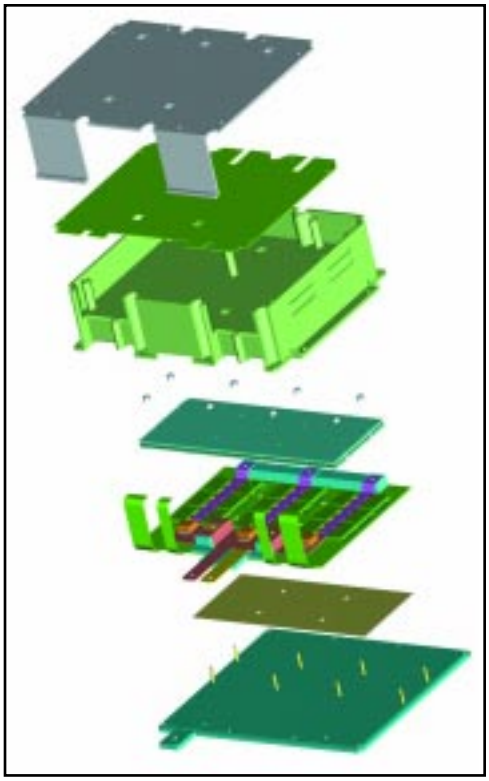
The program's specifications are set at 4.58L unit volume and 11kg weight. The primary challenge, however, is the $7/kW cost target that equates to $385/unit in production quantities of 100,000 units per year. The relatively low production volumes contribute to the challenge of achieving technical and cost goals.

Technology Description

SatCon's top-down design approach integrates electrical design, mechanical packaging, and manufacturing processes to provide a $7/kW module. Functional partitioning provides a standard building block that can be interfaced to varied motor position sensors and low-voltage power supplies.

SatCon's integrated controller includes:

- Modifiable motor control algorithms,
- Automotive grade built-in-test/self-protection capability,
- A low-voltage interface compatible with automotive EMI/EMC/ESD requirements, and
- Component selection and placement compatible with automotive thermal extremes.



SatCon's lightweight, 55-kW AC motor converter with all components integrated into one compact and lightweight module.

Other technology features include a low-power gate drive design, vibration- and shock-tolerant packaging, a low-cost heat sink design, and standardized interconnects for system-level integration.

Accomplishments

SatCon's current design has been reduced by $200 during the past year. Through a detailed Bill of Materials, planned configuration changes, low-cost manufacturing, and "leveraged procurements," SatCon anticipates that AIPM modules will be produced for the target price in 2004.

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SatCon has established an AIPM developmental production facility at the FMI/HYCOMP Division in Marlborough, Mass. The company's new, automated electronics production line will ensure low-cost, high-volume AIPM production.

SatCon's AIPM hardware has progressed from conceptual to detailed design. The company expects to build 10 prototypes by mid-spring and commence design verification testing in the summer. Production validation testing is planned for the latter part of 2001.

FMI/HYCOMP AIPM automated electronics production lines, plus test and assembly area.

Benefits

- SatCon's approach will demonstrate that off-the-shelf manufacturing techniques, advanced design processes, and standard production materials can be combined to produce a low-cost, high-efficiency inverter to power and control an HEV's traction motor without overly sophisticated packaging or semiconductor technology.
- SatCon's packaging will also result in a low-cost, highly capable power converter that can be used "as is" or developed into a much broader range of power electronic products.

Future Activities

SatCon intends to build 20–30 demonstration/validation units and continue production validation testing until the end of 2001. Late in 2001 and 2002, refinements that will enable an even lower cost will be tested in a third-generation, production-target design.

SatCon is working with a number of customers to develop power electronic systems for a wide range of applications, including automotive fuel cell pump drives, flywheel energy storage, fuel cell DC to AC power conversion, and scalable power conversion systems for the Navy Electric Ship Programs. All are candidates for the AIPM-derivative technology.

Partners in Success

- International Rectifier (IR)
- Northrup/Grumman
- PNGV Electronic Tech Team
- SatCon Technology Corporation